

SECOND SERIES  
OF  
EXPERIMENTS  
WITH THE  
FAIRLIE ENGINES,  
ON THE  
FESTINIOG,  
BRECON AND MERTHYR,  
AND  
BURY PORT AND GWENDREATH VALLEY  
RAILWAYS,  
ON  
JUNE 16th, 17th, 18th, and 20th, 1870.

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London:  
F. C. MATHIESON, PRINTER, BARTHOLOMEW HOUSE, E.C.  
1870.

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The following Gentlemen were present at the Experiments

COLONEL DICKENS, R.A., Secretary Public Works' Department, Government of India, Calcutta.

COLONEL STRACHEY, R.E., Acting Secretary, Public Works Department Government of India, Simla.

CAPTAIN STANTON, R.E., Deputy Consulting Engineer, Railway Department, Bengal.

CAPTAIN C. H. LUARD, R.E., Deputy Consulting Engineer, Railway Department, Bengal.

CAPTAIN H. MORELAND., Secretary, Harbour Board, Bombay.

H. LEE SMITH, C.E., Chief Engineer, Northern Punjab State Railway, Lahore, India.

H. J. WYLIE, Resident Engineer, Northern Punjab State Railway, 9, Victoria Chambers, Westminster, London.

W. CROSS BUCHANAN, C.E., Chief Engineer, Mexican Railway, Mexico.

G. LAIDLAW, Toronto, Grey, and Bruce Railways, Upper Canada.

A. M. RENDELL, C.E., Chief Engineer East India Railway, 8, Great George Street, London.

W. BARTON WRIGHT, Locomotive Superintendent, Madras Railway, Madras.

F. S. GILBERT, C.E.

R. H. TAIT, of Glasgow.

PETER BROTHERHOOD., of BROTHERHOOD & Co., Engineers, Staffordshire.

T. C. GLOVER, of GLOVER & Co., Railway Engineers and Contractors, Bombay.

T. J. DEWAR, C.E., of the same firm, Bombay.

GEORGE ALLAN, C.E., SMITH, FLEMING, & Co., 18, Leaden-  
hall Street, London.

THE HONOURABLE R. C. HERBERT, Director, Cambrian Railway.

F. C. DANVERS, C.E., India Office, London.

G. J. MORRISON, C.E. (J. BRUNLEES, C.E.), 5, Victoria  
Street, London.

THOS. CARGILL, C.E., 12, Beaufort Buildings, Strand,  
London.





The FAIRLIE Double Boiler Double Bogie Engine "Little Wonder."



Built for the Festiniog Railway, North Wales, by the FAIRLIE Engine Company,

## EXPERIMENTS ON THE FESTINIOG RAILWAY

WITH THE

"WELCH PONY," ORDINARY LOCOMOTIVE TANK ENGINE,

AND THE

"LITTLE WONDER," FAIRLIE ENGINE,

ON

THURSDAY, JUNE 16th, 1870.

*DESCRIPTION OF THE LINE.*

This is a single line of way,  $13\frac{1}{4}$  miles in length, commencing at Festiniog and terminating at Portmadoc. The difference in elevation from the sea level to the upper terminus is 700.62 feet. The gradients are continually ascending, the maximum being 1 in 60.68, and the minimum, 1 in 186, except on the Traethmawr embankment, where the line is practically level. The average gradient is 1 in 92 for  $12\frac{1}{2}$  miles.

The gauge of the line is 1 ft.  $11\frac{1}{2}$  in.

The minimum curves have a radius of  $1\frac{3}{4}$  chains, and their lengths range from 80 to 200 feet.

With the exception of a short distance at the Portmadoc terminus, which is laid with rails of 30 lbs. to the yard, not fished at the joints, the line is laid with double-headed rails of 48.66 lbs to the yard, placed upon cross sleepers of larch 4 ft. 6 in. X 9 in. X  $4\frac{1}{2}$  in., at intervals of 3 feet, except at the joints, where the centre bearing is 2 feet. There is a framing fixed at every joint, which is arranged by placing two sleepers as longitudinals under the cross sleepers,



spiked together. The joints are fastened with socket fish plates, which embrace the web and lower head of the rail, and are fastened together with fish bolts and nuts.

The cant, or super-elevation, of the outer rail is 3 inches in the curves of minimum radius.

### *DESCRIPTION OF ENGINES.*

The "Welch Pony" is a four-wheel tank engine, with an auxiliary four wheel tender. It has two outside cylinders, each  $8\frac{1}{2}$  inches in diameter. The weight, exclusive of tender, is 10 tons. The weight of the tender is 1.25 tons. The diameter of the wheels, which are coupled, is 2 feet. The wheel base is 5 feet, and the length of stroke 12 inches.

The "Little Wonder" is a double bogie engine without tender. Each bogie has four wheels coupled, 2 ft. 4 in. in diameter. The wheel base of each bogie is 5 ft. That of the engine is 19 ft.. Each bogie has a pair of outside cylinders  $8\frac{1}{8}$  inches in diameter, with a 13 inch stroke. The weight of the engine in working order is 19.5 tons.

In the following experiments, both the engines were fired with Ruabon coal. They had both recently come out of the workshops. The "Welch Pony" had been overhauled expressly for these experiments, and the "Little Wonder" had been repaired in consequence of receiving some damage in a collision.

### *EXPERIMENT No. 1.*

The experiments were commenced at 11 A.M., and in order to afford all an opportunity of judging of the relative steadiness of the "Welch Pony" and that of the "Little

Wonder," they were each run three times consecutively along the Traethmawr embankment, from Portmadoc to the signal post. This portion of the line is straight and nearly level.

#### EXPERIMENT No. 2.

. In this experiment the "Welch Pony" started from Portmadoc with the following train:—

77 loaded waggon, weighing as follows:—

	T.	C.	Q.
Tare weight ... ..	48	5	0
Freight of slates ... ..	143	8	3
<hr/>			
Gross weight ... ..	191	13	3
Weight of passengers ...	2	0	0
Weight of engine and tender	11	5	0
<hr/>			
General total ...	204	18	3
<hr/>			

The length of the train was 711 feet.

The pressure of steam at starting was 140 lbs. The maximum pressure was 150 lbs, which occurred at the foot of the first incline. The minimum pressure was 132 lbs., and that at stopping was 138 lbs.

The fire was clear at starting, and the engine was stoked once. She slipped once at starting, the weather being wet and the rails slippery.

The engine, when on a gradient of 1 in 100, was pulled up by the load. The end part of the train being on a gradient of 1 in 85.65, and the whole of it on a reversed curve.

The second portion of the experiment was commenced by detaching 37 trucks, and the train was then backed until it was altogether on an incline of 1 in 85.65.

The weight of the train then follows:—

	T.	C.	Q.
Weight of 40 waggon, tare	24	17	2
Freight ... ..	74	10	1
<hr/>			
Gross weight of waggon's ...	99	7	3
Weight of passengers ...	■	0	0
Weight of engine and tender	11	5	0
<hr/>			
Total gross weight of train	112	12	3
<hr/>			

The engine started with the slack part of this load, about 30 waggon, but it ~~could not~~ moved the last waggon, with steam at 147 lbs., but was unable to draw it. The wheels did not slip, therefore there was no want of adhesion, and the regulator was full open. Then nine ~~waggon~~ waggon were detached, reducing the total number to 31, and the total gross load of the train to 90 tons 3 cwt. ■ qrs. With this load ■ start ~~was~~ made, with the pressure of steam at 150 lbs. The engine slipped afterwards and stopped, and the steam fell to 148 lbs. It rose to 150 lbs. subsequently, and the engine again started on ■ incline of 1 in 85·65, and drew the load up it. The maximum pressure ~~was~~ 150 lbs., and the minimum, 125 lbs. The pressure at stopping was 138 lbs. The engine slipped several times during this experiment, and ~~the~~ finally stopped by signal after advancing about 25 chains on a gradient of 1 in 90. No sand ~~was~~ used ~~on~~ the rails to prevent slipping, except ■ the first start from Portmadoc.

### *EXPERIMENT No. 3.*

The "Little Wonder" started from Portmadoc with the ~~train~~ 77 waggon and passengers that had been the subject of the previous experiment. The gross load of the train ~~was~~ 218 tons 3 cwt., the difference in the weight of

the present and former train being due to the difference in the weights of the respective engines. The pressure of steam at starting was 150 lbs., rising gradually on the embankment to 160 lbs., which was the maximum pressure attained. The minimum pressure was 135 lbs., which was also the pressure at stopping. The engine was stopped by signal at the same place where the "Welch Pony" was stopped in the last part of the previous experiment, which was about one mile and 60 chains from the terminus. Sand was used on the ascent beyond the embankment in this experiment.

It is to be noticed, that while the "Welch Pony" laboured considerably in drawing its load of 31 waggons in this experiment, the "Little Wonder" drew a load of 77 waggons freely in Experiment No. 3.

#### *EXPERIMENT No. 4.*

In this experiment the "Little Wonder" was started from Portmadoc, with the following train:—

125 waggons, including two loaded ones:—

			T.	C.	Q.
Gross weight	...	...	81	2	0
7 passenger carriages and	...	...	10	10	0
Boat carriage	...	...	0	12	0
Passengers	...	...	3	0	0
<hr/>					
Total weight	...	...	95	4	0
Weight of engine	...	...	19	10	0

---

Total weight of train ... 114 14 0

---

The pressure of steam at starting was 160 lbs. The maximum was 170 lbs. The minimum was 135 lbs., and the pressure at stopping was 140 lbs. The total length of the train, which was an ordinary mixed one, was 1,245 feet.



The engine freely drew this load to the Duffws Station, 13½ miles. It was observed that even at the sharpest curves and at maximum speed, there was very little perceptible oscillation or vibration in the engine, or in the carriages. The condition of the permanent way was remarkably good. The time occupied, including stoppages, was 1 hour 17½ minutes. Sand was freely used on the journey, where necessary, as customary. The day was drizzly, and the rails greasy.

The engine returned with an ordinary passenger train, in 1 hour 8 minutes. The speed on the ascent was estimated to reach at some times as much as 20 miles an hour. On the descent it was as much as 30 miles an hour for short periods.

#### EXPERIMENT No. 5.

This experiment was made with the "Welch Pony." She started from Portmadoc with 38 loaded waggons and passengers. The weights are as follows:—

	T.	O.	Q.
Weight of waggons—tare ...	28	19	1
Freight ... ..	74	6	2
<hr/>			
Total weight... ..	98	5	3
Weight of passengers ...	2	0	0
Weight of engine and tender	11	5	0
<hr/>			
Total gross weight of train	111	10	3
<hr/>			

The pressure of steam at starting was 140 lbs. Immediately after starting, the stoker put on the brake without orders, and brought the train to a standstill. It then started again with steam at the same pressure, which was on the Traethmawr embankment to 145 lbs., which was the maximum.



The engine pulled up by the load on a gradient of 1 in 90, at about  $1\frac{1}{2}$  miles from Portmadoc. Immediately it found the engine was beat the injector put on, which instantly reduced the pressure from 125 to 120 lbs.

The engine started with a good fire, and not stoked, except just previously to stopping. On her return to Portmadoc the fire examined, and the bars, smoke box, and tubes were found to be perfectly clean.

This last experiment made with a view to taining if the "Welch Pony" would take up a weight more nearly approximating to the load which she might have been expected to take (having reference to her weight as compared with that of the "Little Wonder," and the load drawn by that engine) if she had not been previously stopped the incline by a load beyond her powers.

The description of the Festiniog line, and the engines in use upon it, as well as the weights of the trains, &c., referred to in these experiments, are given on the authority of Mr. Spooner.

The experiments and the results, as above described, were fully discussed in public meeting, Col. Strachey in chair, and were approved and signed by—

B. STRACHEY, R.E.

C. H. DICKENS, R.A.

A. RENDELL.

W. BARTON WRIGHT.

C. H. LUARD.

H. LEE SMITH.

PETER BROTHERHOOD.

C. GLOVER.

F. GILBERT.

W. BUCHANAN.

G. JAMES MORRISON.

CHAS. DANVERS.

T. J. DEWAR.

## THE FAIRLIE ENGINE ON THE 4 ft. 8½ in. GAUGE.

*Experiment with the Engine "Progress" on the Mid-Wales Railway,  
from Tal-y-Llyn to Torpantau, June 18th, 1870.*

The "Progress" is a double-bogie engine on the Fairlie system, carrying its own fuel and water. Its principal dimensions and weights are as follows:—

Each bogie has four wheels coupled, 4 ft. 6 in. in diameter. The wheel base of each bogie is 5 feet, and extreme wheel base of the engine, 22 feet. Each bogie has a pair of outside cylinders, 15 in. in diameter, with a 22 in. stroke. The weight of the engine in working order is 54 tons. Length over all 32 feet. The "Progress" was taken out of the workshop expressly for this experiment; having been sent in to receive a new axle-box in lieu of one that was broken. There was no time to adjust the slide valves, which consequently worked unevenly, and there was a considerable leak at a joint in the exhaust pipe from one of the cylinders, which also had not been repaired for want of time.

The line between Tal-y-Llyn and Torpantau, is a portion of the Brecon and Merthyr Railway, and is noted for its long heavy gradients and sharp curves. It will be seen from the annexed section that an incline of 1 in 88·82 commences at the Talybont station, extending for 6½ miles.

The weather at starting was favourable, but when the engine had proceeded about half way up the incline, the mist from the mountains had rendered the rails greasy.

The "Progress" started from Tal-y-Llyn junction at 1 hr. 44.30 min. with the following train:—

15 loaded waggons.

	r.	■.	Q.
Tare weight ...	67	3	0
Freight ...	85	5	0
2 Vans ...	16	0	0
Passengers ...	2	0	0
Total weight...	170	■	■
Weight of engine ...	54	0	0
Gross weight of train ...	224	8	0

The length of train, including engine, was 823 feet.

The details of these weights were supplied by the manager of the line.

The pressure of steam at starting was 115 lbs. It fell to 95 lbs., and again to 100 lbs. on reaching Talybout at 1 hr. 53.10 min. On leaving Talybout Station, which is at the foot of the incline, at 1 hr. 57.50 min. there was a steam pressure of 128 lbs., which fell to 125 lbs. on the incline of 1 in 85, which is the gradient for the first half mile, the engine slipped a little. On getting to the incline of 1 in 38.82, the pressure increased to 137 lbs., and fell again to 134 lbs. when the injector was turned on. The minimum pressure on this part of the incline was 128, but it rose again to 134 on reaching the 80 yards of 1 in 60 at 2 hrs. 11 min., passing over this to the 1 in 38.82 again, the steam commenced to fall gradually until it reached the minimum of 121 lbs., when the injector, which had been continuously at work since first turned on, was closed at 2 hrs. 47.80 min.

About one minute afterwards the experiment was brought to a close by the train being overtaken by an ordinary

passenger train; sufficient time not having been allowed to elapse between the starting of the two trains. This occurred at a point  $5\frac{1}{4}$  miles up the incline before mentioned.

The total time occupied by the experiment was 1 hour 4 minutes from the starting at Tal-y-Llyn Station.

The engine laboured considerably throughout with the load, which was manifestly too great for her in her then condition, as is indicated by her slow rate of progress up the incline.

The fuel used on this occasion was Welsh steam coal, and the engine was stoked six times between 2 hrs. 23 min. and the end of the trial. No sand was used throughout the experiment.

The return journey was made with the engine and the two vans only. Many of the gentlemen rode on the foot plate, and had an opportunity of observing the character of the motion of the engine at a considerable speed (estimated at 50 miles per hour), and of witnessing the working of the counter pressure steam brake, which was put into operation by Mr. Fairlie himself three times with perfect success.

(Signed)

R. STRACHEY.

HENRY J. WYLIE.

FRED. CHAS. DANVERS.

A. M. RENDELL.

C. H. DICKENS.

G. ALLAN.

F. S. GILBERT.

T. J. DEWAR.

THOMAS C. GLOVER.

G. JAMES MORRISON.

THOMAS CARGILL.





NOTE.—The name of the Engine was changed from "Pioneer" after it was sold.



Built for the Oscarsham Railway, Sweden—but sold by permission to the Burry Port and Gwendreath Valley Railway—by the FAIRLIE Engine Company, Offices, 9, Victoria Chambers, London S.W.

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*Experiments with the "Mountaineer" (Fairlie Engine) on the Burry Port and Gwendreath Valley Railway, June 20th, 1870.*

### DESCRIPTION OF RAILWAY.

The Burry Port and Gwendreath Valley Railway is a mineral line, formed in the bed of an old canal, and consists of a continuous succession of sharp curves and steep gradients. The sharpest curve has a radius of 7 chains. The steepest gradient is 1 in 45, with the exception of a short piece at Burry Port, which is 1 in 32.18. The line is of standard gauge, laid with transverse sleepers and flange rails, weighing 40 lbs. per yard on the level, and 45 lbs. on the inclines, and fished at the joints in the usual manner.

### DESCRIPTION OF ENGINE

The "Mountaineer" is a double bogie engine, with four cylinders, 10 inches in diameter and 18-inch stroke. The bogie wheels are coupled, 3 ft. 6 in. in diameter. The wheel base of each bogie is 5 feet, and the total wheel base of the engine, 21 feet. The weight of the engine in working order is 25 tons.

The coal used during the experiments was from the Broad Oak Colliery.

### EXPERIMENT No. 1.

The "Mountaineer" commenced her trial with the following train of 16 waggons and passengers:—

	T.	C.	Q.
Tare weight ...	61	19	0
Freight ...	66	2	0
Total ...	128	1	0
Passengers ...	2	0	0
Engine ...	25	0	0

Gross Total

155 1 0

The engine started, with steam at 160 lbs., from the top of the steep incline at Burry Port. She drew the train easily, but lost steam very rapidly. The fire upon starting was black and overcharged, notwithstanding which it was stoked nearly continuously during the experiment. It must be explained that the "Mountaineer" does all the work of the Burry Port line, consequently there is but one driver, who, unfortunately for the experiments, had recently been discharged, and the man appointed to supersede him had only started an hour or two before we arrived, he had never been on the engine or over the line; it was, therefore, decided by the manager to put on a driver for the experiments the man who had been stoking a short time for the discharged driver, because he knew the road, and with him, as stoker, a man who was employed about the yard coupling up the coal waggon, but who never had been on any engine before—a very good and substantial reason why the engine did not maintain steam. We were assured by the manager that the engine steamed almost too well, their only difficulty being to keep it down. This had been thoroughly proved by the experiments previously made by Mr. Geo. Berkeley and others with this engine, when driven by its regular driver.

In spite of these drawbacks the load was taken as far as  $6\frac{1}{2}$  miles from the starting point, when the steam having fallen to 80 lbs., the train was stopped for a time. With the exception of a few short pieces of straight, the whole line up to this point is a constant succession of reverse curves.

After a short pause the journey was resumed with steam at 157 lbs., and ended with steam at 85 lbs. The distance run was  $5\frac{1}{2}$  miles, making a total distance of  $11\frac{1}{2}$  miles in  $28\frac{1}{2}$  minutes.

The furnaces being in the bad condition as before, it was determined to run the train back, and try the

experiment over again; but on arriving at Burry Port, it found that the man, in his anxiety to stoke and poke the fires, which he was continually doing, notwithstanding the remonstrance of Mr. Fairlie, had broken two of the fire bars, which had dropped out. The bars were quickly replaced, but it was necessary to rake out the fire in order to perform this operation, it found that time would not admit of carrying out this experiment.

### *EXPERIMENT No. 2.*

In the meantime, in order to afford an opportunity of comparing the relative steadiness of the "Mountaineer" with that of the "Gwendreath" tank engine, the latter was run over a portion of the line several times. The result fully bore out the conclusions arrived at in the former experiments with the "Little Wonder" and the "Progress" to the superior steadiness of the double bogie engines.

### *EXPERIMENT No. 3.*

Steam having been again got up in the "Mountaineer," a further trial was made, with the train, of her haulage power up the incline of 1 in 32.18. The engine started on the level, about 100 yards from the foot of the incline, with a pressure of steam of 155 lbs. It should be here remarked that the approach to this incline is an exceedingly bad bit of road, with a multiplicity of points and crossings laid in a careless and rough manner.

The engine drew this train to the top of the incline, when the pressure at stopping was 143 lbs.

### *EXPERIMENT No. 4.*

The trial having succeeded, the train was run back again, and another waggon was attached, weighing 10 tons 14 cwt. With this train weighing in the aggregate 164



about 50 yards from the foot of the same incline. The pressure at starting was 157 lbs., and at stopping, after surmounting the incline, 137 lbs.

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*EXPERIMENT No. 5.*

It was resolved to ascertain whether the engine could haul the same load up the incline when starting at its foot, being thus deprived of the momentum acquired in the previous experiments. A start was therefore effected whilst the engine was on the crossings, with steam at 160 lbs., but after proceeding a little more than half way up, and although sand was freely used, she slipped, and was pulled up by the load, the gauge standing at 150 lbs.

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*EXPERIMENT No. 6.*

A final trial was now made, the starting point being at the foot of the incline. The pressure of steam was 157 lbs., and the engine had nearly completed her task; when unfortunately the tail waggon got off the rails at the points at the foot of the incline, which brought the experiments to an abrupt termination.

The delay occasioned by this accident prevented any repetition of the trial, as the train by which the party were to leave Burry Port was nearly due.

(Signed)

HENRY J. WYLIE.

F. S. GILBERT.

FRED. CHAS. DANVERS.

GEO. ALLAN.

THOMAS C. GLOVER.

T. J. DEWAR.

THOMAS GARCHI.



Previous to the foregoing experiments taking place, letters were received from the Managers and Engineers of the Railways on which the Fairlie engines are employed, and as the facts there stated ~~are~~ important, as shewing not only the economy resultant from their working but the satisfactory manner in which that work is performed, it was considered desirable that extracts from the letters in question should be appended to this report.

The following will be read with much interest:—

The letters in question are all addressed to

ROBERT F. FAIRLIE,  
9, Victoria Chambers, Westminster,  
LONDON, S.W.

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From T. D. ROBERTS, Esq.,  
Engineer of the Brecon and Merthyr Railway.

“Brecon, May 2nd, 1870.

“Replying to your favour of the 30th ult., I have to say that we have no means of ascertaining the exact loads carried by the ‘Progress’ and other engines, one reason being that we always work two or three engines together up and down the inclines, and of course can only count the number of waggons from the engine to the nearest slack coupling. It is often the ~~case~~ also that a train is composed of merchandize which is never weighed. We have, however repeatedly proved the engine capable of taking up the long incline a load of 160 tons within the hour—she did so when Mr. Berkeley was here†—and, ~~we~~ we always load

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† In proof of this (see page 11) the “Progress” (although crippled by the valves being out of order, the engines being hurriedly thrown together, and taken immediately out of the shops for the experiment) took over 170 tons 5½ miles over the long incline, which includes the half mile of 1 in ~~2~~ starting from the station at the foot of the incline. The rails were slightly wet starting up

them to the full extent of their power, you have a right to assume that the average gross load taken on every trip by the 'Progress' is over 150 tons. In the eleven working days mentioned in the paper I sent you (see copy of paper referred to following this letter) she carried two trips each day between Talylyn and Pant, viz.,  $4 \times 150 \times 11 = 6,600$  tons (*this is only averaging 150 tons per trip, instead of 160*).

"Then with respect to the loads carried by the 'Cyclops' and 'Severn,' we are much in the same position, but we do know that the 'Progress' and one or other of the other two working together up the incline will take four more iron ore waggons than two of our ordinary tank engines—say the 'Cyclops' and 'Severn'—will take with 120 lbs. per square inch of steam in the boiler. This would give an increase of 46 tons in favour of the 'Progress.' The tonnage carried by the 'Severn' or the 'Cyclops' in the eleven days would therefore be 4,576 tons. I regret we are not able to give you more precise figures, but I think these are to all intents and purposes as near the actual work as they can be got.

"I am glad to say the engine performs her work most satisfactorily. We have no difficulty in keeping up steam.

"Yours truly,  
(Signed) "T. D. ROBERTS."

The following is copy of the paper referred to in Mr. Roberts's letter. The information was taken from the Companies' books, for, and handed to, Mr. Geo. Berkeley, engineer of the Great Indian Peninsular Railway. The paper gives the actual consumption of fuel and stores used, and total cost of working one fortnight on the Brecon and Merthyr Railway, over the same section of lines, the same number of miles run in the same number of days, between the engines "Progress," "Cylops," and "Severn." The engines worked not only the same days, but the same times of days; consequently the atmospheric and other influences were the same in each case:—

"CYCLOPS," ordinary type, 6 wheels coupled, tank engine, specially designed and built by Sharp, Stewart, & Co., for working the heavy inclines and sharp [redacted] of the Brecon and Merthyr Railway.

Cylinders 17 inches diameter, 24 inches Stroke, 6 Wheels coupled 4 feet 6 inches diameter

11 Working days } = 935 miles—  
1 Shed day }

			s.	d.		£	s.	d.
Coal ...	...	23 tons 10 cwt. at	10	0	...	16	5	0
Oil ...	...	4½ gals	3	7	...	0	15	3
Tallow ...	...	33 lbs.	0	5½	...	0	14	5
Waste ...	...	15 lbs.	0	2½	...	0	3	8
Hemp ...	...	6 lbs.	60	0	...	0	2	11

Wages:—

Driver ...	...	0	7	0
Fireman ...	...	0	3	0
Cleaner ...	...	0	1	■

12 Days at .. 0 11 8 ... .. 7 0 0

£25 0 10

Cost per mile, 6.43d.

### "SEVERN,"

Twin Engine to "Cyclops," built by the [redacted] Firm.

11 Working days } = 935 miles—  
1 Shed day }

Coal ...	...	30 tons 16 cwt. at	10	0	...	15	8	0
Oil ...	...	5½ gals.	3	7	...	0	19	4
Tallow ...	...	29 lbs.	0	5½	..	0	12	0
Waste	} Same as "Cyclops"	...	...	...	...	7	6	2
Hemp								
Wages								

£24 5 6

Cost per mile, 6.24d.

**"PROGRESS," Fairlie Engine.**

Four Cylinders 15 inches diameter, 22 inches Stroke, 8 Wheels  
coupled in two sets.

11 Working days }  
1 Shed day } = mileage 935

			s.	d.		£	s.	d.
Coal ...	34 tons 6 cwts.	at	10	0	...	17	3	0
Oil ...	8½ gals.	,,	3	7	...	1	9	7
Tallow ...	11 lbs.	,,	0	5½	...	0	4	10
Waste ...	27 lbs.	,,	24	0	...	0	6	0
Hemp ...	8 lbs.	,,	60	0	...	0	4	4

**Wages :—**

Driver ...	0	7	0
Fireman ...	0	4	0
Cleaner ...	0	3	4

12 Days at 0 14 4 ... .. 8 12 0

£27 19

Cost per mile, 7.18d.

"Progress,"—For 6,600 tons hauled, the coal used is 34 tons cwt., being .54 lbs. of coal per ton per mile.

"Cyclops."—For 4,576 tons hauled, the coal used is 32 tons 10 cwt., being .74 lbs. per ton per mile.

"Severn."—For 4,576 tons hauled, the coal used is 30 tons 16 cwt., being .71 lbs. per ton per mile.

It will be seen from the foregoing that the "Progress" with a consumption of 34 tons 6 cwt. of coal hauls 6,600 tons in the same time as the "Cyclops" or "Severn" hauls 4,576 tons with an average consumption of coal of 31 tons 13 cwts. or, in other words, the "Progress" with a consumption 9.7 per cent. more coal does 44.5 per cent. more work, the total cost for the "Progress" is 7.18 pence per mile run, while the average of the "Cyclops" and "Severn" is 6.34 pence. That is, the "Progress" does

actually 44.5 per cent. more duty at an increased cost of only .84 pence per mile; or the total cost of hauling the said 6,600 tons with engines of the "Cyclops" — "Severn" class would be £35 11s. 3d., compared with £27 19s. 9d., the cost of haulage with the "Progress."

*From GENERAL MALCOLM, Managing Director of the*

*"Burry Port and Gwendreath Valley Railway,*

*"Dated 67, Sloane Square,*

*"28th May, 1870.*

"I am happy to say the engine works very well and most economically. I wrote to our Superintendent the other day desiring him (as he reported that — slack) to use our small four-wheeled engine, and save the 'Mountaineer' (the latter is the Fairlie engine); his — was that she worked — more economically than the smaller one."

*From GEORGE REDFORD, Traffic Superintendent.*

*"The Burry Port and Gwendreath Valley Railway Company,*

*"Dated Burry Port, Carmarthenshire,*

*"28th May, 1870.*

"I am sure its success is perfect and everything — could wish for; in fact, for light roads and curves, I cannot speak too highly of it. It is quite a treat to be with the 'Mountaineer,' after having been used to our other engine, and I — convinced that if the objectors to your system would only have a ride — both engines they would — alter their opinions. I frequently take a trip with them, and — therefore speak from experience. The 'Mountaineer' will do more work than our other engine, and burn less coal, and the difference it makes to the road one can hardly explain. The 'Mountaineer' passes over the 50 lb. rails without making the least impression, and in the — there is no tendency to spread the gauge although it is slower than heavier



*From CAPTAIN LUCKRAFT, General Manager of the*

*"Burry Port and Gwendreath Valley Railway Company,*

*"Dated Burry Port, Carmarthenshire,*

*"1st June, 1870.*

"I have only time to say a few words in reply to yours of the 31st May.

"To your first query I am not able to give you detailed statistics, for the driver neglected to give me the information, but I can give a gross estimate, for the same amount of work done; the 'Mountaineer' will consume about 2 tons of coal, when the other, the 'Gwendreath,' consumes 3 tons, and in a comparison of eleven days, the consumption of oil and tallow was as under:--

" 'Mountaineer' ('Fairlie' Engine)	Oil	11 quarts.
" "	Tallow	7 lbs.
" 'Gwendreath' (Ordinary Engine)	Oil	7 quarts.
" "	Tallow	11 lbs."

*From C. E. SPOONER, Esq., Engineer and Manager,*

*Portmadoc and Festiniog Railway.*

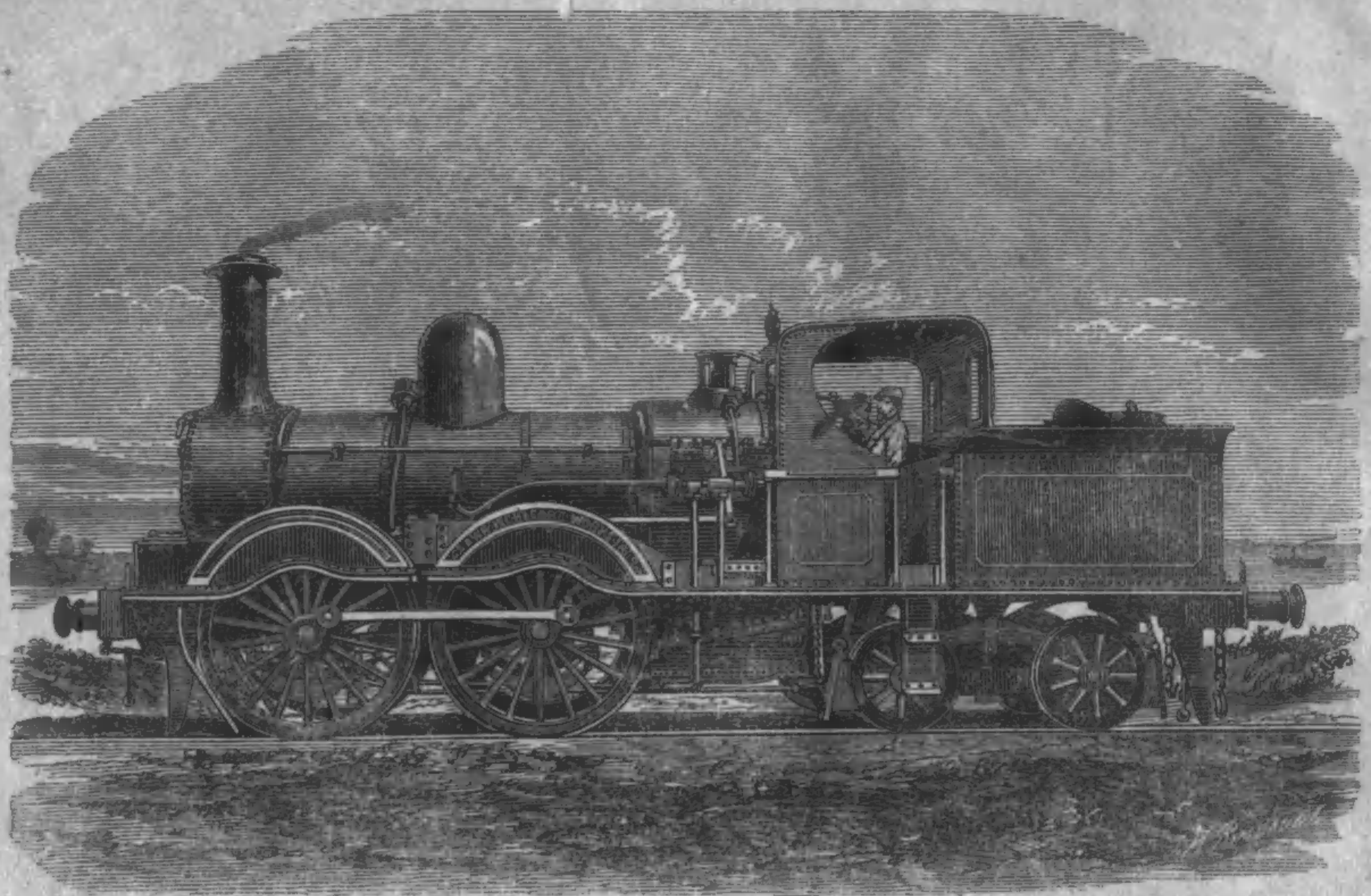
*"Dated Bron y Garth, Portmadoc,*

*"1st June, 1870.*

"You will be glad to hear the 'Little Wonder' has been at work for some time since her unfortunate collision in the fog; and now that she has been overhauled and put right again, is doing her work well. She drew a train last week with her up the line weighing 80 tons, of 400 yards in length, at the rate of 16 miles an hour, using but 3 cwt of coal the whole journey up, being equal to 24.8 lbs. per mile with that load over 700 feet rise in 13½ miles, but with the addition of the coal used on the down journey (half hundredweight) making 3½ cwt. over 27 miles, the consumption is only 14.5 lbs. per mile."



The FAIRLIE Single Boiler Double Bogie Engine.



Designed and built by A. McDONNELL, Esq., Engineer of the Great Southern and Western Railway of Ireland. at the Locomotive Works, Inchicore, Dublin.

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961



The following letter, with regard to the single boiler double bogie engines built for the Great Southern and Western Railway of Ireland, was received subsequently by Mr. Fairlie, from A. McDonnell, Esq., the engineer of the company:—

(Copy.)

“Great Southern and Western Railway,

“Loco. Engineer's Office,

“Inchcore, Dublin,

“19th July, 1870.

“Dear Sir,

“In reply to your enquiries as to the two double bogie engines built in these works on your system, one has run 5,677 miles and the other 3,867 miles. They both worked as pilot engines when turned out new, and afterwards as passenger engines with slow trains, the average running speed of the trains they work is from 25 to 30 miles an hour, and the load from 4 to 9 of our large 6-wheeled carriages.

“The weight on the wheels is well distributed, being 10 tons on each pair of wheels of the steam bogie, and 8 tons on each pair of wheels of the trailing bogie in working order, with water enough to run from 20 to 25 miles, and coal enough for the run from Dublin to Cork (165 miles). The engines make steam extremely well and the consumption of coal is low.

“The drivers consider it 3 or 4 pounds a mile less than the average. I will however let you know more exactly soon, when they have worked longer as train engines. The engines work very freely, run very steadily, and are very handy. They have given no trouble, except a little with the steam pipes, which I made at first without any joints, but altered since.

“They will run round curves of 100 feet radius, and run freely round curves of 300 feet radius, which is all I require them to do in practice.

“Yours truly,

(Signed) “A. McDONNELL.

“R. F. FAIRLIE, Esq.”